



## Characterization and evaluation of Pashmina producing Changthangi goat of Ladakh

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### ABSTRACT

Changthangi is a well recognized breed of goat popular for its valuable produce called pashmina. The breeding tract of this goat is in the Changthang area of Leh district of Jammu & Kashmir State and is adjacent to Tibet. The breed is well adapted to the local cold arid agro-climatic conditions of the region and is reared mainly by a nomad known as 'Changpa'. The fibre produced by this breed is the prime source for the world-class shawl industry of Kashmir. The study was carried out in 15 strata comprising 50 villages and their adjoining areas distributed throughout the breeding tract of the breed. The information collected include nature and type of native environment of the breeding tract, managerial practices, different physical characteristics like body colour, head profile, ears, horns, coat characteristics, body measurement traits; production traits like body weight at different ages, Pashmina production and quality traits, dairy performance, carcass characteristics and reproduction traits of Changthangi goat. Pashmina is unique among the animal fibres for its warmth, lightness and better ability to absorb dyes and moisture compared to mohair and wool. In addition to pashmina, this goat is also reared for chevon, milk, manure, pelt and even carriage. The number of this goat is presently in decline and restricted mainly to Changthang area. Changthang region has harsh climatic dryness (with very low rainfall) and temperature varies from  $-40^{\circ}\text{C}$  to  $+40^{\circ}\text{C}$ . The majority of the animals have white coat, though brownish red, fawn, grey and black animals are also seen. The horns are brown and mostly curved in shape. The average pashmina production was  $248.60 \pm 4.18$  g/animal. The overall fine hair, guard hair, dusting loss percentages, fibre length, guard hair length, scouring yield and fibre diameter were  $62.36 \pm 2.56\%$ ,  $31.98 \pm 2.94\%$ ,  $12.18 \pm 1.40\%$ ,  $4.09 \pm 0.04$  cm,  $56.90 \pm 2.80$  mm  $70.52 \pm 1.51\%$  and  $11.99 \pm 0.22\mu$ , respectively. The major breeding season is July- November. The information generated from this study shall be of immense help in devising scientific improvement programmes for this breed.

**Key words:** Changthangi goat, Milk, Management, Pashmina, Production, Reproduction, Survey

Changthangi, a well recognized breed of goat popular for its valuable produce called pashmina, is distributed in the Changthang area of Leh district of Jammu & Kashmir State and is adjacent to Tibet. The breed is well adapted to the local cold arid agro-climatic conditions of the region and is reared mainly by a nomad known as 'Changpa'. The fibre produced by this breed is the prime source for the world class shawl industry of Kashmir. The banning of use of Shahtoosh fibre has further increased the importance of this goat as a source of finest quality fibre. The cost of this fibre is highest among domestic animal fibres and in international

market was 90–180 Eu/kg in 2004 AD. The cost determining factors of the fibre are its fineness, color, length and pureness. The Changthangi goat is the only fine fibre (pashmina) yielding goat breed of India besides Chegu. India produces the best quality pashmina of the world with an annual production of about 40 tonnes, but this is merely less than 1% of the total world production of pashmina. The number of this goat is presently very reduced and restricted mainly to Changthang area. The reduction in number of pashmina goats is because of low return and high mortality in the area. So, there is an immediate need of initiating improvement programs for conservation and ensuring better utilization of this breed with more economic returns. Undertaking any scientific breeding programme for this purpose, requires a base line authentic data giving—population size, production and reproduction potentials, and its uniqueness for some economic attributes. Therefore, a scientific survey

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programme of Changthangi goat for characterization and evaluation under field condition was undertaken in its actual breeding tract to assess its importance so that this breed can be saved for future.

#### MATERIALS AND METHODS

An organized field study was conducted on Changthangi goats of Ladakh region of India by Division of Animal Genetics and Breeding, Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir, Shuhama, Srinagar as part of the ICAR sponsored project entitled "Characterization, Improvement and Conservation of Pashmina (Changthangi) Goats in the Ladakh (Jammu and Kashmir)". A set of four detailed questionnaires was developed by National Bureau of Animal Genetic Resources, Karnal, the apex institute responsible for breed characterization and conservation in India. Information was collected from 15 strata (Table 1) comprising 50 villages and their adjoining areas distributed throughout the Changthang area, the breeding tract of the breed. The information collected include nature and type of native environment of the breeding tract, managerial practices followed by the farmers, different physical characteristics like body colour, head profile, ears, horns, coat characteristics, body measurement traits; production traits like body weight at different ages, Pashmina production and quality traits, dairy performance, carcass characteristics and reproduction traits of Changthangi goat.

#### RESULTS AND DISCUSSION

*Origin and distribution:* In modern literature the breed is generally described as Changthangi goat as per the name of its breeding tract. The Changthangi goats are also known as 'Changra' (*Chang = Changthang, ra = goat*). Goats of Ladakh are all dwarfs in size, pashmina producing and are also used to carry burden. This type of goat is distributed throughout

the Tibet and this breed is much smaller than any of the north Indian goat breeds.

The origin of cashmere goats has been traced to *Capra falconeri* by some authors (Harris 1962, Misharev 1963, Epstein 1969, Roberts 1969) and to *Capra hircus blythi* by others (Kiyatkin 1968), with 3 main domestication centres: North-East Kirgizia, South-East Tibet and North-West Mongolia (Fig. 1). This grouping is based on the number of scales per 100µm length of outer fibres. This parameter of differentiation is also suggesting that these groups have different origins and different species.

The breeding tract is an area of about 24, 000 square km lies in the Leh district of J&K State between 32° 30'to 34°–00'NL and 77° 50'to 79° 10'EL.

*Native environment and topography of breeding tract:* The breeding tract of the Changthangi goat falls in the cold arid region of western subcontinent between the Karakoram and the Greater Himalayas interwoven with barren and rugged mountains (Fig. 2) forming some main valleys and collateral valleys of Changthang area. The terrain is mostly mountainous and denuded. The Changthang area is divided into two rural developmental blocks- Durbuk and Nyoma. The elevation of the area varies from 3340 to 4560 m above MSL and these elevations correspond to Liksey and Korzook villages, respectively. The animals are reared extensively in the pastures up to 5200 m above MSL.

Changthang region has harsh climatic dryness (with very low rainfall) and temperature varies from hot to extreme cold. The area is known a Cold Himalayan Desert and has very low thermal and hydric indexes. July and August are the hottest and the January is the coldest months. The minimum and maximum temperature fluctuates between –40°C to 40°C and rainfall is very meager. The average relative humidity varies between 13–90% with the highest humidity corresponding to the lowest temperature. The snowfall in the area is very scanty and when it occurs it is dry and powdery. Wind velocity in the

Table 1. Stratum identified in the breeding tract to characterize Changthangi goat

Name	Elevation (M above MSL)	Name of villages
Liksey	3340–3510	Shara, Liksey, Tulka, Tulka Pho, Trachit
Chumathang	4000–4050	Chmathang, Keria, Ney, Skithmong & Kesar
Chushul	4310	Chushul Valley
Pangong Tso	4 300–4420	Man-Merik, Spangmik, Kakstl & Phobrang
Kargyam	4320–4500	Satuu, Lungburma, Kharbulu, Chibru, Tibetan Settlement.
Durbuk	3890–4000	Tangste, Durduk, Shyok, Shashakul, Tharuk & Chelam
Samad	4560	Samad Valley, Rahchun and adjoining areas
Kharnak	4560	Kharnak valley and adjoining areas.
Kurzook	4420–4490	Kurzook, Samdho, Ankum and Monastery
Nyoma	4170	Nidder, Noyma, Mud, Tibetan Settlement.
Anley	4200	Rango, Anley, Khaldo, Pongog
Koyal	4200	Koyal & Demjok and adjoining area.
Tasga	4400	Tsaga village
Phobrang	4500	Phobrang, urgoo and Lukung
Rumtse	3500	Rumstae, Gaya, Miru

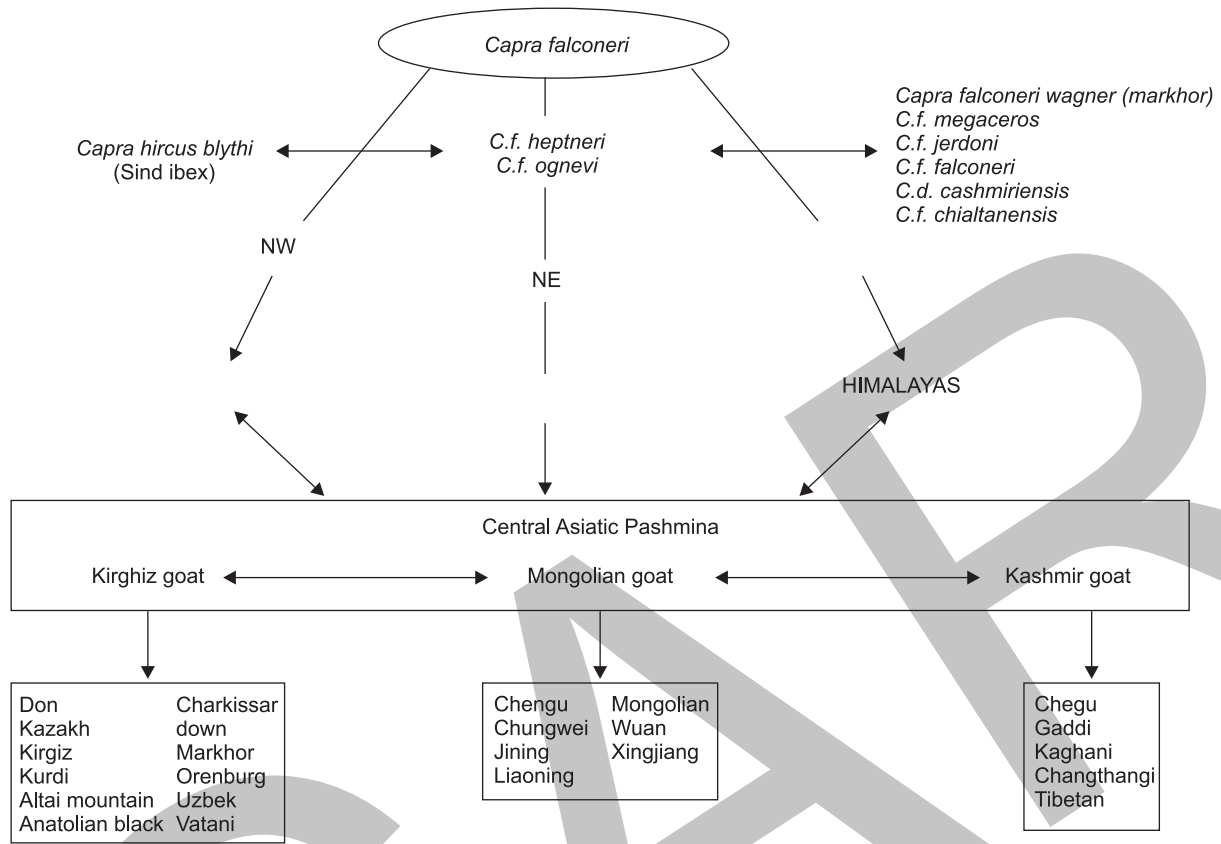


Fig 1. Probable origin of Asiatic pashmina producing goat [Adopted from Millar (1986)]

area is very high and the fallen snow gets accumulated in the gorges and this remains up to summer. In summer melting of this snow causes regeneration of various grasses in the area. Most part of the breeding tract remains closed from November to April due to closure of passes.

**Community rearing the breed:** The *Changthang* is an area inhabited by the Changpa tribe. All of them practice Buddhism as their religion. The Changpas are traditionally nomads and their livelihood mostly based on rearing of goat, sheep and yak. In spite of having the permanent settlements, Changpas rear their flocks under complete extensive system and migrate their flocks throughout the year in search of fodder. Most of the flocks migrate on their defined routes

mutually agreed between the breeders of different villages. Some shepherds of the village to which the flock belongs manage these flocks. The villages of the Kharnak, Samad and Korzok area migrate along with their flocks to longer distance throughout the whole year. The Changpas live in tents (*rebo*) (Fig. 3a,b) all the year round and migrate along with their flocks in accordance with an old established annual routine between the pastures that exist wherever an occasional stream carrying snowmelt from heights makes possible the growth of grass, scanty indeed. At Korzok, 4560 M from MSL, the highest cultivation field in the world, barley is cultivated in few fields, though there is no guarantee that the crop will ripe.



Fig 2. Landscape of Changthang area



Fig 3. (a) Outer, and (b) inner views of a typical Rebo



**Population status:** The *Changpas* have mixed sheep and goat flocks. The age and sex-wise estimated population of the Changthangi goat is presented in the Table 2. Males are kept in larger numbers than in other breeds of goat because of the fact that the castrated males are kept in the flock to carry luggages in the pastures and get pashmina out of them.

Table 2. Estimated population of Changthangi goat (2003)

Age group	Male	Female	Total
Kids (0–6 months)	24672	24, 468	49, 140
Young stock (6–12 months)	17271	17127	34, 398
Adult (1 year and above)	18, 575	56, 378	74, 953
Total	60, 518	97, 97 3	1, 58, 491

#### Managemental practices

**Feeding:** The Changthangi goat is exclusively maintained on natural grazing during summer. The animals remain in the pasture (Fig. 4) throughout the day from morning till evening. The grasses growing naturally in the area are extensively grazed by the animals. No cultivated grass is fed at the lower elevations. When snow melts, the nutritious clover crops up in the pastures are fed but in winter the dried surface grasses and some under sand herbs and shrubs, after removing the top soil by hooves, are eaten by the goat. Only during severe winters, if there is snowfall and the grasses become covered by the frost, barely, palletted concentrate feed and some dried grasses are fed to the animals, otherwise the flocks remain on surface grazing only. The concentrate feed is provided by the Sheep Husbandry Department on subsidized rates. Fodder and feed resources are short, in general, in the area and improvement of pastures is essential for sustaining this breed and other animals in the area.

The area has thin and sparse vegetation. There are 3 types of plant categories found in the area - cushion plants, dwarf plants and woody plants. Out of these plant species 5–6 types of grasses are growing in the riverine or marshy areas and utilized by animals as fodder. However, it was observed that roots of some of the shrubs especially while grazing in dry lands are consumed by the goats. The elevation of the pastures in Changthang area is up to 5000 m above MSL. The various

types of vegetation cover of the pastures are grasses like *Poa pratensis*, *Festuca rubra*, *Bromus macrostachy*, *Elymus sibiricus*, *Agropyron lange-aristatum*, wild clover, *loma*, *pangsa*, *nergyal* (*Astragalus* sp), *kibu* etc.; legumes like *Astragalus tribulifolius*, *Oxytropis microphylla*, *Ciecr microphyllum*; bushes and trees like *Caragana vesicolor*, *Myricaria germonica*, *Myricaria prostrate*; major fodder shrubs locally known as *sehyoah*, *troia*, *aabry*, *somoede*, *burwak*, *yakzes*, *ambang*, *kyandon*, *taksha*, *shyyoung*, *snalo*, *tseery*, *sarolo*, *talo*, *chyut*, *umbo*, *sirma*, *shaya*, *penmaa*, *sonam shepa*, *loma*. The dry fodders are prepared from wild pasture grasses as well as straw of barley. A high altitude variety of barley is the only food grain cultivated in some areas and fed to the animals only during severe winter crisis.

Only during winter animals are fed on dry fodders @ 1.0–1.5 kg/goat/day. Concentrates @ 200–400 g/day is provided only during extreme winter conditions. Kids only suckle their mothers up to 2 week of life and thereafter kids are sent out along with flocks and they start nibbling on blades of grasses. No systematic weaning of kids is done in the area and therefore no milk replacer is provided. During summer the water sources in the pastures are the melting of snow and glaciers. But during winter season when the atmospheric temperature is far below the freezing point the perennial water sources in the form of springs are the major sources for watering and animals take even snow/ice for quenching their thirst in areas where sufficient water from the springs is not available. The soil and water in the area are deficient in iodine and zinc. However, sulphur is in high quantity in the soils. No mineral in harmful quantity is reported from the area.

**Housing:** Goats are kept in paddocks (Fig. 5) during night. The paddocks have wall of stones piled in an orderly fashion in such a way that air may pass through it. At places the paddock are made by dried bushes and their roots. The bushes have strong and extensive root system because of arid atmospheric conditions. The animal house has no roof. The animals are let out for grazing early in the morning and comeback to paddocks in the evening. There are no *kaccha* or *pacca* animal houses anywhere in the breeding tract. The animals are kept under the open sky in all the seasons. The floor of paddocks has 3–4 inch thick sandy soil. There is no drainage in the paddock and there is not even need for it as



Fig 4. Pashmina goats grazing in the pasture land.



Fig 5. Pashmina paddock for night time housing.

the environment is arid and therefore chance of dampness of floors of the paddocks is minimized drastically. Housing space of these animals varies during summer and winter. A space area of 9 m × 9 m is sufficient to accommodate 300 animals during winter and only 200 during summer. Animals of all the ages are housed in same paddock and the goat are housed with the sheep. *Rongpas* (stationary Changpas) sometimes provide a *kaccha* type of house in extreme winters.

No special housing is provided during kidding and kids are kept in the open paddocks and the dams are allowed for grazing after 2–3 days of kidding. At some places, especially at high altitudes the young kids are kept in dugged out holes with some old cloth lining provided to these holes. They are taken out of holes only for milk feeding. This is done to avoid direct wind exposure to kids, as the winds blow at very high speed. The sick kids are also kept in these holes. The sick animals are kept in the tents, where the Changpa themselves live.

**Disease incidence and mortality:** The occurrences of the diseases in this breed of goat in its native tract are very less. Common bacterial diseases affecting the Changthangi goat are diarrhoea and clostridial diseases, but occasional incidence of Brucellosis are also reported. The commonly reported viral diseases are foot-and-mouth disease, ecthyma, goat pox and contagious caprine pleuro-pneumonia (CCPP). Among the parasitic diseases, *Eimeria* (coccidia) and few cases of *Moniezia nematodirus* species and *Haemonchus* species were also observed. The goats are vaccinated against FMD, pox and clostridial diseases (dysentery, struck, malignant oedema, pulpy kidney, black's disease). For protection against the clostridial disease, multi-component clostridial vaccine is administered. Anthelmintic dosing of animals is done from time to time in accordance with season and parasitic loads in the flocks. Dipping on large scale against mange and ectoparasites is done periodically. The kid mortality in Pashmina goats decreases with increasing age and comes down from 28.34% in 1–2 months age group to 2.17% in 9–12 months age group. The overall mortality up to 1 year of age was 54.30%. The main causes of mortality are respiratory diseases, nutritional reasons, attack by wild animals as well as exposure of the kids to extreme cold climatic conditions of the region. The adult animals also show the similar trend of decrease in mortality with increasing age. The overall average mortality ranged from 5.79% in more than 4 years to 11.73% in 1–2 year age group.

**Livestock migration:** In Changthang area livestock (sheep, goat and yak) is reared under extensive and completely migratory system of rearing. The livestock remains in migration throughout the year with defined routes to tread and camping spots to stay. The duration of stay at a given spot depends upon the availability of grazing on the land surface and also the migration pressure of other flocks. In most of the Changthang the mixed flocks of sheep and goats are reared by the shepherds or persons deputed by the

villagers turn by turn in the vicinity of the permanent villages or pasture nearby in radius of 10–15 km, except in revenue village Phobrang where livestock migrate to farther distances. The three villages in the region namely, Kharnak, Samad – Rokchan and Korzok are almost totally migratory and almost all the families of these villages move with their livestock. The migration pattern is mutually agreed by the animal rearers. In each migration cycle the leader flock(s) is/are the flock(s) owned by the monastery followed by the flock of *Amchee* (traditional village physician). Flocks of the other villagers follow these flocks in the migration route. The stay in the route, movement and the areas to be grazed by different flocks in and around the migratory route(s) are mutually decided by the villagers.

#### *Physical characteristics*

**Coat colour:** In Changthangi breed majority of the animals are of white (Fig. 6a, b). The brownish red, fawn, grey and black animals are also seen. The admixture of colour is white and black or white and fawn. The predominance of white colour in the breed is of great significance keeping in view the dependence of pashmina fibre colour, wherein white fibres fetch highest prices in the market because of their rarity (Belleli 1982) and suitability for dyeing without bleaching. In the two organized Government farms of goats in Leh all the animals kept are white, thereby, heralding the fact that it is possible to have all the white coat animals in the field if proper breeding plan is followed. In some flocks coloured and spotted animals are more than white animals. The head is convex in almost all of the cases. In general, the Changthangi goat has a typical convex head with a long tapering face. Both the ears are straight and short. The males have slightly longer ( $12.50 \pm 0.46$  cm) ears than the females ( $12.20 \pm 0.41$  cm). All the adult animals have 2 horns. No polled animals were seen in the area. This may be probably due to the fixation of the gene for horned condition in the population as there are reports that polledness in goat is having selection disadvantage because of inter-sexuality associated to polledness. In most of the cases the colour of horn was brown, while in some cases black and white horns were also found. The shape of horns is curved in most of the cases (87.5%) while few animals had straight (12.5%) horns. The males have longer ( $25.18 \pm 1.25$  cm) horns than females ( $24.10 \pm 0.19$  cm). Wattles were absent in all the animals. The tail in Changthangi goat is short to medium in size. In 4% animals the tail is very short and in most of the cases (96%) it is medium in size. The tail is thin and straight in all the cases. The average length of tail in males and females were  $11.33 \pm 0.28$  and  $11.25 \pm 0.25$  cm, respectively.

**Morphometric measurements:** The males (Fig. 6a) have higher body length but females (Fig. 6b) have higher length at girth and height at wither compared to the kids of other sex at birth. At 3, 6 and 9 months of age the males dominated in these traits. The females have higher body length, whereas

Table 3. Measurements of Changthangi goat for different morphometric traits

Traits	Birth		3 months		6 months		9 months		1–2 years	
	Male (N=341)	Female (N=346)	Male (N=325)	Female (N=316)	Male (N=340)	Female (N=333)	Male (N=352)	Female (N=356)	Male (N=385)	Female (N=372)
Body length (cm)	26.78 ±1.02	26.28 ±1.03	38.48 ±0.67	37.97 ±0.64	49.94 ±1.10	49.87 ±1.12	43.41 ±0.70	41.61 ±0.56	51.31 ±0.68	51.77 ±0.70
Length at girth (cm)	27.13 ±0.90	27.23 ±0.84	40.42 ±0.65	40.41 ±0.52	54.48 ±1.09	53.40 ±1.09	54.89 ±0.67	52.06 ±0.55	65.85 ±0.50	64.71 ±0.51
Height at wither (cm)	28.07 ±0.69	28.32 ±0.60	37.93 ±0.57	37.92 ±0.58	52.46 ±1.07	52.24 ±1.17	41.70 ±0.41	40.71 ±0.33	52.71 ±0.42	51.99 ±0.44

males have higher values for other two traits at 1–2 years of age. Acharya (1982) has reported higher estimates of body conformation traits in adult males and females. The measurements for different morphometric traits at different ages of Changthangi goats are given in Table 3.



Fig 6. Pashmina (a) Buck and (b) Doe

#### Production characteristics

**Body weight:** At the time of birth females are heavier than the males, but afterwards males started to grow faster than the females achieving higher body weight at three months of age. But no significant variability in body weight is found between the 2 sexes at 6 months of age. Animals do not grow too much between 9 and 12 months of age in spite of the fact that it is the growing phase of the animals. This is due to the extreme winter condition which corresponds with this phase of the age. Males are either equal or better than the females in body weights. Change of body weight of Changthangi goat at different ages in both the sexes has been presented in Table 4.

**Milk production:** Most of the milk produced from the animals is consumed by the kids and remaining milk is very little. Table 4. Body weight (kg) of Changthangi goat of different sexes and ages

Age	Male		Female	
	N	Mean±SE	N	Mean±SE
Birth	341	1.47±0.08	346	1.54±0.07
3 months	325	7.89±0.28	316	7.45±0.18
6 months	340	14.45±0.38	333	14.45±0.37
9 months	352	15.94±0.20	356	13.40±0.17
1–2 year	385	16.67±0.17	372	16.12±0.17

often used for family consumption. The average milk yield were observed as 272.74±5.04 ml with a range of 170 to 500 ml/day. The does are not milked during February to April as the surface grazing is very scanty because of cold-arid climatic conditions. At that time the animals are maintained in a very low level of nutrition and the kids are allowed to suckle all the milk. From May to September when sufficient grazing facility is available the milk is taken from the does for human consumption too.

**Pashmina production:** Cashmere is the principal high value produce from the cashmere and related types of goats. It is also known as Kashmir, pashm, pashmina, tiflit, tiftik, tivit, tibit etc. which is the undercoat from these goats, is one of the finest natural fibres, with diameter ranging from 8–15µ, and is used in the manufacture of luxury goods. The cashmere fibres are non-medullated and lack crimp. On an equal weight basis, this fibre has 3 times the insulating capacity of wool (Von Bergen 1963) but, because of its ultra structure, it is weaker than wool and is more susceptible to wetting (Ryder 1984). The strength of cashmere fibres is about 10% below that of the finest sheep wool, and about 40% below that of mohair (Von Bergen 1963). Changthangi goat's body is covered by two types of hairs: the guard hair and the pashmina fibres. The pashmina grows on neck, body and hind quarter. Faces and legs have no pashmina growth. However, the guard hair covers almost all the body except face and a small lower portion of legs. The pashmina fibre grows from secondary follicle whereas hairs grow from the primary follicles. The pashmina production is believed to start in summer solstice (from 21 June, the longest day) to onset of winter solstice (21 December, the shortest day), thereafter there is no growth



Fig 7. Harvesting of pashmina and equipments for harvesting

of fibers. The pashmina grown on the body protects the animals from the severe winter experienced in the Changthang area where temperature drops down to  $-40^{\circ}\text{C}$ . The pashmina fibre is shed on the onset of summer (May-June). The fibers are harvested from the animals by specially made iron combs or shearing (Fig. 7). Pashmina is harvested once in a year in late spring, when it has become loose from the follicles and is held within the coat by the outer fibres. The animals are combed from 2–7 days for harvesting the pashmina. All the legs of animals are tied with rope and the combing is started. The animals are combed and the shed pashmina gets entangled between the teeth of the comb and is removed from time to time while combing. The number of days required to get the total harvest of pashmina by combing depends upon the level of shedding from the secondary follicles. In some animals 2–3 combings are sufficient whereas in other animals more combing may be required. The pashmina obtained by combing contains a considerable amount of hair and are subsequently separated to get pure pashmina. The pashmina is collected as per colour of the fibre and sorted separately. The animals are harvested first time at about one year of age. Though combing is the major way of harvesting pashmina, in settled villages

the harvesting is also done by shearing followed by manual separation.

The overall pashmina production was  $248.60 \pm 4.18$  g with a range of 50 g to 650 g per animal. There is higher pashmina production from males than females and with increasing age production increases. Deb (1998) estimated lower amount (138.6 g) of pashmina production from Chegu breed of goat in the Kumaon Himalayas. Age and sex-wise pashmina production by the Changthangi goat is presented in the Table 5.

**Fibre quality:** The overall fine hair, guard hair, dusting loss percentages, fibre length, guard hair length, scouring yield and fibre diameter were  $62.36 \pm 2.56\%$ ,  $31.98 \pm 2.94\%$ ,  $12.18 \pm 1.40\%$ ,  $4.09 \pm 0.04$  cm,  $56.90 \pm 2.80$  mm,  $70.52 \pm 1.51\%$  and  $11.99 \pm 0.22$   $\mu$ , respectively. Darokhan and Tomar (1983) and Ganai *et al.* (2004) reported average fibre length of 4.95 and 4.86 cm, respectively. Ganai *et al.* (2004) found that the average fibre diameter varies from 12.16–12.55  $\mu\text{m}$ . Lower (65.29%) scouring yield than the present finding was observed by Darokhan and Tomar (1983), whereas Acharya (1982) found it much higher (85%). The details of different fibre quality parameters of pashmina are presented in Table 6. The

Table 5. Sex and age-wise pashmina production (g) in Changthangi goat

Sex		Age group			Overall (744)
Male (368)	Female (376)	$\geq 1$ year (214)	1–4 years (334)	>4 years (196)	
256.90 $\pm$ 6.64	240.68 $\pm$ 5.10	201.43 $\pm$ 17.75	242.50 $\pm$ 4.58	270.36 $\pm$ 9.22	248.60 $\pm$ 4.18

Table 6. Pashmina fibre quality traits of Changthangi goat

Traits	Fine hair/ Pashmina (%)	Guard hair (%)	Dusting loss (%)	Fine hair length (cm)	Guard length (mm)	Scouring yield (%)	Fibre diameter (m)
Young (22)	48.37 $\pm$ 3.83	51.66 $\pm$ 3.84	15.40 $\pm$ 2.81	4.86 $\pm$ 0.12	-	-	-
Adult (30)	72.63 $\pm$ 1.90	17.56 $\pm$ 1.23	9.82 $\pm$ 1.17	3.34 $\pm$ 0.84	-	-	-
Overall (52)	62.36 $\pm$ 2.56	31.98 $\pm$ 2.94	12.18 $\pm$ 1.40	4.09 $\pm$ 0.04	56.90 $\pm$ 2.80	70.52 $\pm$ 1.51	11.99 $\pm$ 0.23

Table 7. Sex and age-wise average fibre diameter ( $\mu$ ) of Changthangi goat

Sex		Age group			Overall (590)
Male (310)	Female (277)	<2 years (290)	2–4 years (193)	>4 years (107)	
11.98 $\pm$ 0.17	12.08 $\pm$ 0.17	12.09 $\pm$ 0.17	12.04 $\pm$ 0.22	11.86 $\pm$ 0.26	11.99 $\pm$ 0.22

Table 8. Carcass traits of Changthangi goat

Traits	Weight at slaughter (kg)	Carcass weight (kg)	Dressing percentage (%)	Skin weight (dry) (kg)	Skin length (cm)	Skin width (cm)
Male (62)	35.85 $\pm$ 0.56	15.27 $\pm$ 0.31	42.65 $\pm$ 0.54	2.95 $\pm$ 0.14	101.48 $\pm$ 2.40	56.98 $\pm$ 1.41
Female (87)	27.67 $\pm$ 0.34	11.75 $\pm$ 0.21	42.66 $\pm$ 0.64	2.22 $\pm$ 0.09	93.12 $\pm$ 1.35	52.59 $\pm$ 1.25
Overall (149)	31.04 $\pm$ 0.45	13.22 $\pm$ 0.23	42.66 $\pm$ 0.43	2.52 $\pm$ 0.08	96.75 $\pm$ 1.34	54.43 $\pm$ 0.95

males produce fibres finer than females. The fibre diameter also varies among animals of different age groups (Table 7).

**Carcass traits:** The average age at slaughter is between 20–60 months. The males are slaughtered at younger age (20–32 months) than the females (32–60 months). Males are heavier when they are slaughtered and produce more carcass weight compared to the females. However, the dressing percentage is almost same in both the sexes. The details of different carcass traits are given in Table 8.

#### *Reproduction characteristics*

There is marked seasonality in the reproductive behavior of Changthangi goats. The major breeding season is July–November. Only natural mating is practiced in this breed and a buck is allotted to 25–40 does for breeding.

The age at first mating for male goat is 2–2.5 years, whereas it is 1.5 years in females. The oestrous cycle lasts for 21 to 22 days with oestrous duration of 36–48 h. The gestation and service periods were  $151.08 \pm 0.50$  and  $227.79 \pm 7.52$  days, respectively, in Changthangi goats. The kidding starts in February at higher altitudes and goes up to June. However, main kidding season at high altitude is February to April, though a few kids come thereafter also. Contrary to the kids in the flock, the farmers prefer the extreme winter condition for kidding as there is low mortality of the newborns during this period. The kids, in particular, are highly sensitive to fluctuation of temperature because of weakly developed thermoregulatory system. The average age at first tupping, age at first kidding, kidding interval, kidding percentage and litter size were found to be  $550.33 \pm 7.20$  days,  $699.44 \pm 10.23$  days,  $366.45 \pm 3.43$  days,  $97.58 \pm 2.23\%$  and  $1.02 \pm 0.50$ , respectively. On an average, the Changthangi does mate 6 to 8 times in a lifetime.

The incidences of abortion and still birth are very rare (<1%) in Changthangi goat. Infectious metritis and pyometra are rarely reported. However, reproductive disorders due to nutritional deficiencies occur when the pastures are not good in the area.

The present study was the first systematic documentation of pashmina producing Changthangi breed of goat in its actual breeding tract. It has generated detailed information on various morphological, production and reproduction characteristics of this breed which were not systematically documented before. The knowledge gathered from this study will be helpful in developing plans for package of managerial practices, breeding plan and conservation of this unique animal genetic resource found in the northern part of our country. As the population size of this breed is in decline, inbreeding poses as a major threat in near future.

Thus, awareness programmes for educating the farmers regarding better feeding, management, health care practices, and proper breeding plans to be followed, will help in development of a sustainable and profitable rearing system for Pashmina goat.

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